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Development and study of sandwiched layer ceramic membrane

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ABSTRACT

Phenol is a harmful water pollutant affecting human health. Thus removal of phenol is important for water treatment. The present research aims at the development, characterization and application of a sandwiched layer ceramic membrane for removal of phenol from aqueous solution. The membrane was developed using inexpensive river clay through paste casting technique at 980°C. The membrane was characterized by Brunauer Emmett Teller (BET) apparatus (Autosorb-1, Quantacrome, USA), field emission scanning electron microscope (FESEM, JEOL JSM-7610F with EDS module), X-ray diffraction (XRD) analysis and Fourier transform infrared spectroscopy (FTIR, Perkin Elmer, USA). The BET surface area (S_{BET}, m^2/g) and average pore size (d_{Avg}, Å) of the crushed membrane were determined as 0.89 m^2/g and 84 Å respectively. The porosity of the casted membrane was calculated as 43% using water. The average pore size of the membrane was found to be 9.96 µm measured using water whereas, the pure water permeability was found to be 1×10^{-6} m/s-kPa. The porosity values measured by BET and water might differ due to the particle size, fluid used and applied pressure. The compressive strength of the membrane was calculated as 2.33 MPa. The membrane was employed for the removal of phenol at varying applied pressure (196–392 kPa), initial concentration (30–120 mg/L) and cross flow rate (0.08×10^{-7}–2.4×10^{-6} m^3/s). A significant enhancement of the permeate flux was observed from 792 to 1008 LMH (2.2×10^{-4} to 2.8×10^{-4} m^3/m^2-s) with increase in applied pressure from 196 to 392 kPa for a feed concentration 100 mg/L due to the increase in driving force. The cost of the membrane was evaluated and found to be around Rs. 19 for a single membrane.

Keywords: Ceramic membrane; Phenol; Microfiltration; Driving force; Cost

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